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ABSTRACT

The effects of individually prescribed instruction (IPI) in reading as compared to the traditional mode of instruction are examined. The IPI model includes four components: analysis of subject matter content, diagnosis of student preinstructional behavior, sequencing of materials to facilitate learning, and evaluation strategies. Elementary students in two experimental schools (E1, E2) and two control schools (C1, C2) were administered the vocabulary and the reading comprehension tests of the Iowa Test of Basic Skills at the end of the treatment period. Comparison between the mean grade equivalent scores of E1 and C1 showed that IPI pupils scored equal to or higher than non-IPI pupils in half the cases. Comparison between E2 and C2 showed that while neither group earned the minimum test norm, all IPI pupils had scores equal to or higher than non-IPI pupils. In addition, pupil attitudes toward school and self were more positive in IPI pupils than in their counterparts. It was concluded that IPI does work in the area of decoding and of reading/study skills, and it has produced effective results with a variety of populations. Tables and references are included. (VJ)

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Background

During the 1964-65 school year a new instructional system was introduced to the students and faculty of the Oakleaf Elementary School of the Baldwin-Whitehall School District in suburban Pittsburgh, Pennsylvania. This instructional system bore the label Individually Prescribed Instruction (IPI). It was first introduced through the vehicle of mathematics and has, since then, branched into the areas of reading, spelling and science.

In a paper detailing the Oakleaf Project, Lindvall and Bolvin (14) listed eight assumptions as a basis for planning. These assumptions are:

1. One obvious way in which pupils differ is in the amount of time and practice that it takes to master given instructional objectives.

2. One important aspect of providing for individual differences is to arrange conditions so that each student can work through the sequence of instructional units at his own pace and with the amount of practice that he needs.

3. If a school has the proper types of study materials, elementary school pupils, working in a tutorial environment which emphasizes self-learning, can learn with a minimum amount of direct teacher instruction.

4. In working through a sequence of instructional units, no pupil should be permitted to start work on a new unit until he has acquired a specific minimum degree of mastery of the material in the units identified as prerequisite to it.

5. If pupils are to be permitted and encouraged to proceed at individual rates, it is important for both the individual pupil and for the teacher that the program provide for frequent evaluations of pupil progress which can provide a basis for the development of individual instructional prescriptions.

6. Professionally trained teachers are employing themselves most productively when they are performing such tasks as instructing individual pupils or small groups, diagnosing pupil needs, and planning instructional programs rather than carrying out such clerical duties as keeping records, scoring tests, etc. The efficiency and economy of a school program can be increased by employing clerical help to relieve teachers of many non-teaching duties.

7. Each pupil can assume more responsibility for planning and carrying out his own program of study than is permitted in most classrooms.

8. Learning can be enhanced, both for the tutor and the one being tutored, if pupils are permitted to help one another in certain ways.

The above assumptions suggested that a different framework for instruction would have to be devised. In discussing such a framework, Glaser (8) identified four components that would be of concern to the instructional designer:

> The design components...are (a) analyzing the characteristics of subject matter competence, (b) diagnosing preinstructional behavior, (c) carrying out the instructional process, and (d) measuring learning outcomes.

Inherent in the first component, analyzing the characteristics of subject matter competence, is the notion of subject-matter structure. Bruner (1) supports this notion when he states that

> ...the curriculum of a subject should be determined by the most fundamental understanding that can be achieved of the underlying principles that give structure to that subject.

Writing elsewhere about the importance of structure, Bruner (2) contends that at least four general claims can be made for teaching the fundamental structure of a subject. They are:

1. Understanding fundamentals makes a subject more comprehensible.

2. Detailed material is conserved in memory by the use of simplified way of representing it.

3. An understanding of fundamental principles and ideas...appears to be the main road to adequate "transfer of training".

4. By constantly re-examining material taught in elementary and secondary schools for its fundamental character, one is able to narrow the gap between "advanced" knowledge and "elementary" knowledge.

King and Brownell(13) lend further support to the notion of subject-matter analysis.

> The structure of mathematics, physics or possibly history can be described competently in several ways...This conception of varying patterns of organizing the discipline ...has been recognized by teams of scholars working on national curriculum studies.

Addressing himself to the notion of structure, Phenix(16) is:

> ...convinced that one of the secrets of good teaching is the practice of clearly charting a way through the subject of instruction, so that the students know how each topic as it comes along fits into the whole scheme of the course and of the discipline to which it belongs. They understand where they are in relation to what has gone on before and to what is to be studied subsequently. The effect of such teaching is a growing appreciation of the inner logic of the subject resulting at length in a grasp of its spirit and method which will be proof against the erosions of detailed forgetting.

From an instructional point of view, this analysis of the characteristics of subject matter competence is, perhaps, best translated into terms of behavioral objectives. Gagne' (6) has stated:

> If the goals of instruction are involved in content, these must also be tied to the student's behavior, or perhaps to his expected behavior...More specifically, content may be defined as descriptions of the expected capabilities of students in specified domains of human activity.

Gagne' (7) continues:

> It is the defining of objectives that brings an essential clarity into the area of curriculum design and enables both educational planners and researchers to bring their practical knowledge to bear on the matter.

Attention is now directed to the second of Glaser's (9) components: diagnosing preinstructional behavior.

Travers (18) has stated that there are at least four classes of preinstructional behaviors which are determinants of the course of achievement:

1. The extent to which the individual already has acquired the responses sought.

2. The extent to which the individual has acquired the prerequisites for learning the responses to be acquired.

3. The extent to which the individual has acquired the learning-set variables consisting of antecedent learnings which facilitate or interfere with new learning under certain instructional conditions.

4. The individual's ability to make the discriminations necessary to profit from instruction.

Since those who are concerned with the educational process have no control over the student's behavior up to the point of entering school, then the identification of those prerequisites essential to learning can be an extremely complex task. Consider, for example, the implications of identifying prerequisite behaviors for those who are involved in the teaching of language development in children:

> Teachers must ponder the extent to which they can attempt to alter a system of habits which are not only higly practiced, but which also probably serve a supportive role in the child's adjustment to his non-school environment. (3)

Cronbach (4) further reminds us that the practice of predicting achievement scores at the end of a course by the use of aptitude tests may be questionable:

> In certain of the new curricula, there are data to suggest that aptitude measures correlate much less with end-of-course achievement than they do with achievement in early units.

The third component of concern to the instructional designer has been identified by Glaser (10) as carrying out the instructional process.

He identifies these instructional processes as a way of arranging the student's environment to expedite learning which comprise subject-matter competence. Glaser(11) believes that at least three kinds of processes seem to be involved:

1. Setting up new forms of student behavior, such as new speaking patterns, or a new skill like handwriting.

2. Setting up new kinds of stimulus control, for example, learning to read after having learned to speak, so that the already-learned response of making speech sounds is attached to particular visual symbols.

3. Maintaining the behavior of the student.

Central to the processes just described is the notion of sequence. (12)

Those who are concerned with instructional design should seriously consider the nature of progression through a curriculum. Whether or not one subject is inherently more organized than another is seemingly not as important as the idea that decisions need to be made about what comes before what. In this regard, many of the basic principles of programmed instruction were used in developing the IPI curriculum and instructional procedures. These principles(15) are stated below. While not all of them are sequencing principles per se the discerning reader will readily recognize the relationships that exist between and among them:

1. The objectives to be achieved must be spelled out in terms of desired pupil behaviors.

2. To the extent possible, instructional objectives should be ordered in a sequence which makes for effective pupil progression with a minimum number of gaps or difficult steps and with little overlap or unnecessary repetition.

3. If pupils are to work through a curriculum on an individual basis, it is essential that instructional materials be such that pupils can learn from them without constant help from a teacher and can make steady progress in the mastery of the defined objectives.

4. In individualized instruction care must be taken to find out what skills and knowledge each person possesses and to see that each one starts in the learning sequence at the point which is most appropriate for him.

5. For individualized instruction, conditions must be provided which permit each pupil to progress through a learning sequence at a pace determined by his own work habits and by his ability to master the designated instructional objectives.

6. If instruction is to be effective, it must make provisions for having the student actually carry out and practice the behavior which he is to learn.

7. Learning is enhanced if students receive rather immediate feedback concerning the correctness of their efforts in attempting to approximate a desired behavior.

8. The final criterion for judging any instructional sequence must be its effectiveness in producing changes in pupils, and feedback concerning pupil performance should be used in the continuing modification and improvement of materials and procedures.

The fourth component of an instructional design is concerned with evaluation. In the system know as IPI, attention is directed to evaluation in the beginning, during the course of, and at the completion of work in a particular skill. This appears to be a rather drastic departure from the long practiced idea of testing at the completion of units of work or reporting periods. The IPI concept also views evaluation as being essential to curriculum evaluation and design as well as a means to provide ongoing and effective guidance of learners. This idea is not without support. The following statement is from one of the volumes reporting the Eight-Year Study: (17)

> A third important purpose of evaluation is to provide information basic to effective guidance of individual students. Only as we appraise the student's achievement and as we get a comprehensive description of his growth and development are we in a position to give him sound guidance. This implies evaluation sufficiently comprehensive to appraise all significant aspects of the student's accomplishments. Merely the judgment that he is doing average work in a particular course is not enough. We need to find out more accurately where he is progressing and where he is having difficulties.

Cronbach (5) seems to have given a vote of confidence to the direction evaluation in IPI has taken:

> The three purposes - course improvement, decisions about individuals, and administrative regulations - call for measurement procedures having somewhat different qualities.

In summary, the design of the system of instruction known as IPI is based on four major components: (1) analysis of subject-matter content and student behaviors; (2) diagnosis of the pupil's strengths and weaknesses prior to instruction; (3) sequencing of the materials to facilitate learning; and (4) evaluation strategies applied to the curriculum as well as to the learner.

Application of the Model

By way of introduction to the model, it is important to note that IPI is not a curriculum; it is an instructional system which is (1) based on carefully specified pupil behaviors, and (2) correlated with diagnostic instruments, curriculum materials and teaching techniques. Saying it another way: once the desired behaviors have been specified for any given curriculum, assessments are made relative to the degree to which a given student owns each of the behaviors. By analyzing the results of these diagnoses, the teacher is then able to determine the behaviors that need strengthening and structure learning routes for the student so that, in the final analysis, he can demonstrate his mastery of the acquired behaviors.

Diagrammatically, the system looks like this:

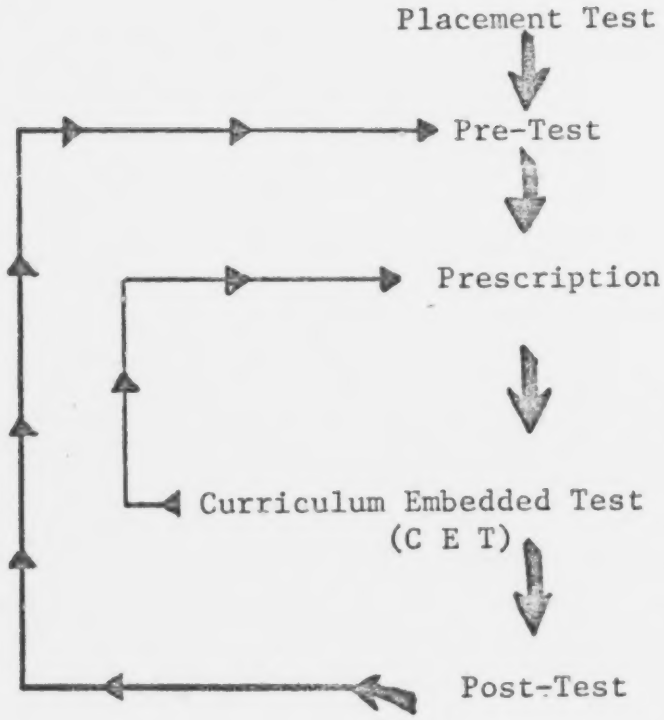
Placement Test
(a sampling from all skills in all levels of the hierarchy)
Pre-Test
(an analysis of all skills within one unit of a level of the hierarchy)
Prescription
(an individual lesson plan which directs the student to materials and professionals so that he may increase his competence in a given skill)
Curriculum Embedded Test
(C E T)
(an analysis, after working in a skill, of the student's competence in that skill)
Post-Test
(an alternate form of the pre-test)

Figure 1

As an example of the application of the model, one of the stages of the IPI Reading Program is concerned with the development, maintenance and improvement of a set of reading skills. Figure 2 is a representation of this "skills continuum" as it is currently being implemented in several field-test sites. The "skills continuum" shown here is neither complete, nor final. It represents only the current stage of development. The numerals in each block represent the number of behaviors or skills that comprise each unit.

	Levels Of Difficulty						
Units	E	F	G	H	I	J	K
Structural Analysis	5	6	4	4	3	4	4
Vocabulary Development	3	2	2	2	2	2	2
Literal Comprehension	3	3	4	3	3	4	3
Interpretive Comprehension	5	4	5	5	4	4	3
Evaluative Comprehension	2	3	4	3	4	4	4
Library Skills	2	3	4	4	4	2	X
Reference Skills	7	5	5	2	4	3	2
Organizational Skills	X	4	3	2	2	4	3
	27	30	31	25	26	27	21

Total 187

Figure 2

By applying the diagram in Figure 1 to the "skills continuum" shown in Figure 2 the practical application of the model becomes visible:

A student takes a placement test in each of the units for each level of difficulty. Once he has demonstrated his level of competency in each unit, he then takes a pre-test in the first unit in which he had demonstrated the least proficiency. The results of this pre-test will determine which skill he will work in and for which he will receive his first prescription.

Continual monitoring of his work in this skill will indicate when he will receive the CET. After completing all of his prescriptions for this skill, he will take a post-test. When the post-test results demonstrate his mastery, he will repeat the cycle in another unit and level.

Supporting Evidence

Pupil achievement. In an age of performance contracting and accountability, the usual question asked is: "How well did the experimental group do in relation to the control group?" The common place method of answering the question is to administer a standardized test to both groups and then to compare the results. While this author does not subscribe to the use of national norms as the sole measure of achievement growth, these data have, nonetheless, been collected and are reported below for two experimental (E_1, E_2) and two control (C_1, C_2) schools.

Schools E_1 and C_1 are located in a rural-suburban section of eastern Pennsylvania. The Iowa Test of Basic Skills was administered to pupils in grades three through six in both schools in the spring of 1970. The results for the Vocabulary and Reading Comprehension Tests, reported as mean grade equivalents, are shown in Table I.

TABLE I

IOWA TEST OF BASIC SKILLS - FORM 3 -

MEAN GRADE EQUIVALENT ACHIEVEMENT BY GRADE

FOR READING SUBTESTS FOR E_1 AND C_1 SCHOOLS

	N		TEST					
			Vocabulary			Comprehension		
Grade	E_1 IPI	C_1 NON IPI	E_1 IPI	C_1 NON IPI	DIFF.	E_1 IPI	C_1 NON IPI	Diff.
3	64	43	4.0	4.3	-.3	3.3	3.7	-.4
4	71	53	4.7	4.8	-.1	4.7	4.5	+.2
5	102	68	5.4	5.6	-.2	5.3	4.9	+.4
6	99	78	6.8	6.3	+.5	6.8	5.6	+1.2

At the time of the administration of the test, the test norm for each respective grade was 3.6, 4.6, 5.6 and 6.6. Using the test norm as the minimum criterion, it can be seen that, in the E_1 group, all but three of the eight grade equivalent means are equal to or higher than this criterion. On a comparison basis, it can be seen that the IPI pupils earned mean grade equivalent scores equal to or higher than the non IPI pupils in half the cases.

Schools E_2 and C_2 are located in an urban setting in south-central Pennsylvania. In both schools, the populations represent that group known as "culturally disadvantaged." The Iowa Test of Basic Skills was administered to pupils in grades three through six in both schools in the spring of 1970. The results for the Vocabulary and Reading Comprehension Tests, reported as mean grade equivalents, are shown in Table II.

TABLE II

IOWA TEST OF BASIC SKILLS - FORM 3 -

MEAN GRADE EQUIVALENT ACHIEVEMENT BY GRADE

FOR READING SUBTESTS FOR E_2 AND C_2 SCHOOLS

	N		TEST					
			Vocabulary			Comprehension		
Grade	E_2 IPI	C_2 NON IPI	E_2 IPI	C_2 NON IPI	DIFF.	E_2 IPI	C_2 NON IPI	Diff.
3	52	120	3.2	2.7	+.5	2.7	2.4	+.3
4	68	80	3.2	2.9	+.3	2.9	2.9	0
5	57	76	4.0	3.6	+.4	4.1	3.2	+.9
6	54	83	4.8	4.2	+.6	3.5	3.3	+.2

It can be seen that neither group earned the minimum test norm. More significant, however, is the fact that in all cases the IPI pupils earned mean grade equivalent scores equal to or higher than the non IPI pupils.

Pupil attitude. Pupil attitude was investigated through the use of an instrument organized in a semantic differential format. The instrument was constructed in-house and included such items as: Reading a book is...; Learning to read new words is...; my reading class is... . The final instrument had two forms. Each pupil was given one form of the instrument to complete, i.e,; half of the pupils had one form, while the other half had the other form. Tests of significance were computed by using chi square. The results clearly support this writer's belief that IPI pupils have a more positive attitude toward school and self than their non IPI counterparts. A large measure of this positiveness is due to the fact that, as mentioned earlier in this paper, IPI students know what is expected of them and they know when the goals have been achieved.

Additional studies. Other studies, both formative and summative, have been completed which suggest favorable reactions to IPI as a positive and beneficial way to achieve an individualized approach to instruction. Some of these studies have shown a significant difference in favor of control groups in terms of achievement data. However, it must also be said that these studies do not indicate whether this difference is a result of the IPI system or the materials that are used to implement the system. This is a very definite distinction that must be made. From this writer's point of view, IPI as an instructional system can and does work - application of the IPI system to decoding in reading has been successful - the maintenance, improvement and reinforcement

of reading and study skills have been successfully adapted to the IPI model - students are frustrated less - they are in control of particular aspects of their learning environment - and, they are happy with themselves.

Summary. The following statements highlight the results of Research for Better Schools' work with IPI:

. Teachers

- have positive attitudes toward teaching under IPI
- use data to make decisions
- change their behavior in working with students
- provide valuable feedback for improving the system

. Students

- achieve as well or better than non IPI students on standardized tests
- achieve higher than non IPI students on IPI tests
- have a positive attitude toward school and learning
- demonstrate a change in social behavior

. The IPI system

- has produced effective results with a variety of populations

FOOTNOTES

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